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October 31, 2002

Mr. Michael Szerlog
START Region 10 Deputy Project Officer
U.S. Environmental Protection Agency
1200 Sixth Avenue, Mail Stop ECL-116
Seattle, WA 98101

RE: Contract 68-S0-01-01
TDD: 02-06-0001

Dear Mr. Szerlog:

Enclosed please find the draft Agrium U.S. Incorporated Kenai Nitrogen Operations Facility Continuous Release Investigation Summary Report, which reviews the continuous release reports from Agrium U.S. Incorporated Kenai Nitrogen Operations facility in Kenai, Alaska. If there are any questions or concerns, please call me or Suzanne Dolberg at (206) 624-9537.

Sincerely,

Dhroov Shivjiani
START-2 Program Manager

Enclosures

cc: Suzanne Powers, EPA Region 10 Task Monitor, Washington Operations Office, Lacey, WA
Sharon Nickels, EPA Region 10 START-2 Project Officer, Seattle, WA, ECL-116 (letter only)
Dhroov Shivjiani, E & E START-2 Program Manager, Seattle, WA (letter only)
Suzanne Dolberg, Project Manager, E & E, Seattle, Washington

# Agrium U.S. Incorporated
# Kenai Nitrogen Operations Facility
# Continuous Release Investigation
# Draft Summary Report
# Kenai, Alaska
# TDD: 02-06-0001

Contract: 68-S0-01-01
October 2002

**ATTORNEY-CLIENT PRIVILEGE**
**FOIA EXEMPT**

Region 10

***START-2***

Superfund Technical Assessment and Response Team

Submitted to: Suzanne Powers, Task Monitor
U.S. Environmental Protection Agency
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AGRIUM U.S. INCORPORATED
KENAI NITROGEN OPERATIONS
CONTINUOUS RELEASE INVESTIGATION SUMMARY REPORT
KENAI, ALASKA

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**APPENDICES**

## LIST OF ACRONYMS

| Acronym | Definition |
|---|---|
| Agrium | Agrium U.S. Incorporated |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CR-ERNS | Continuous Release-Emergency Response Notification System |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| EPA | United States Environmental Protection Agency |
| EPCRA | Emergency Planning Community Right-to-Know Act |
| °F | degrees Fahrenheit |
| KNO | Kenai Nitrogen Operations |
| LEPC | Local Emergency Planning Committee |
| MDEA | methyldiethanolamine |
| NRC | National Response Center |
| P&ID | process and instrumentation diagram |
| ppd | pounds per day |
| psig | pounds per square inch - gage |
| RQ | reportable quantity |
| SERC | State Emergency Response Commission |
| START | Superfund Technical Assessment and Response Team |
| TDD | Technical Direction Document |
| tpd | tons per day |

# 1. INTRODUCTION

On June 3, 2002, the Region 10 United States Environmental Protection Agency (EPA) tasked Ecology and Environment, Inc., (E & E) under the Superfund Technical Assessment and Response Team (START-2) contract (68-S0-01-01) Technical Direction Document (TDD) Number 01-07-0005 to perform a continuous release investigation at Agrium U.S. Incorporated's (Agrium) Kenai Nitrogen Operations (KNO) facility in Kenai, Alaska. As part of the investigation, the START-2 was tasked to investigate all releases reported in Agrium KNO's Continuous Release-Emergency Response Notification System (CR-ERNS) report (CR-ERNS Number 44607) to determine if the releases qualify for continuous release reporting as defined under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 103(f)(2) [40 CFR Parts 302 and 355].

The investigation consisted of a review of the facility's continuous release records and reports and an on-site visit of the Agrium KNO facility between June 25 and June 26, 2002, to review the operational areas identified in the release reports. The objective of this investigation was to determine, to the greatest extent possible, if the releases and operational areas in Agrium KNO's CR-ERNS report qualify for continuous release reporting. A copy of Agrium KNO's CR-ERNS report is provided as Appendix A. Supporting documentation provided to the START-2 by Agrium is included as Appendix B.

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# 2. FACILITY DESCRIPTION

The Agrium KNO facility manufactures ammonia and urea. The KNO facility has the capacity to manufacture 3,800 tons of ammonia per day and 3,500 tons of urea per day. The KNO facility, located at Mile 21 Kenai Spur Highway in Kenai, Alaska, is comprised of five plants: two ammonia manufacturing plants, two urea manufacturing plants, and the utility plant.

Agrium U.S. Incorporated purchased the KNO facility in Kenai, Alaska, from Unocal on October 1, 2000. Up until October 2000, the KNO facility was owned and operated by Unocal and its subsidiaries. The original facility, known as the south complex, consisted of one ammonia plant, one urea plant, and one utility plant (Plants 1, 2, and 3). Unocal completed construction of the south complex in 1969. Unocal then constructed the north complex, consisting of Plants 4, 5, and 6, between 1975 and 1977. Recently, the utility plants have been combined into one utility plant

## 2.1 Ammonia Plants

Plants 1 and 4 at the KNO facility manufacture ammonia using natural gas, steam, and ambient air. The manufacture of ammonia is a five step process that begins with gas preparation and reformation. Sulfur is removed from the natural gas stream by passing it through organic sulfur removal vessels. The sulfur-free natural gas stream then is sent through the primary reformer where it is heated to 1,350 degrees Fahrenheit (°F) by high-pressure steam from the boiler house. The reaction of steam with natural gas (methane) in the presence of a catalyst reforms the gases into hydrogen, carbon monoxide (CO), and carbon dioxide ($CO_2$). Compressed air then is added in the secondary reformer to convert more of the methane to hydrogen and also provides a source of nitrogen that will later react with hydrogen to form ammonia. However, it should be noted that during all the steps of manufacturing ammonia, some of the hydrogen and nitrogen spontaneously react to form ammonia. Therefore, a small amount of ammonia is present throughout the process. (Unocal 1993)

Carbon monoxide and $CO_2$ must be removed from the reformed gas stream before ammonia can be generated. This is accomplished by passing cooled, reformed gas over a catalyst bed that converts CO to $CO_2$. This process is referred to as shift conversion. Because not all of the CO is converted during the first pass, the gas stream goes through another shift conversion to reduce the CO content in the final gas stream (the synthesis gas stream) to less than one percent. (Unocal 1993)

The next step in the process of ammonia manufacture is the removal of $CO_2$ from the synthesis gas stream. The gas from the shift conversion process is passed through an absorber containing methyldiethanolamine (MDEA), an organic fluid that absorbs $CO_2$ from the gas stream. The MDEA solution then is piped to an accumulator where some of the $CO_2$ is flashed off with inert gases. The solution then is transferred to the MDEA regenerator where the $CO_2$ is removed and sent to the urea plant. (Unocal 1993)

The synthesis gas resulting from the $CO_2$ removal process still has enough $CO_2$ in it to cause problems in the reactor during synthesis. Therefore, the gas stream from the $CO_2$ removal process is passed through a catalyst bed and is reacted with hydrogen to form methane. This reaction is referred to as methanation and leaves the gas stream entering the ammonia convertor virtually $CO_2$-free. (Unocal 1993)

The synthesis gas then is compressed to 3,300 pounds per square inch - gage (psig) and sent to the ammonia convertor. The nitrogen and hydrogen in the synthesis gas passes over a catalyst bed and combine to form ammonia. About 15% of the incoming synthesis gas is converted to ammonia. This gas stream then is cooled and passed through a separator to remove liquid ammonia. Unconverted synthesis gas then is recycled to the ammonia convertor to convert more of the synthesis gas to ammonia. (Unocal 1993)

The pressure of the ammonia from the high pressure separator is reduced through a series of flash drums then introduced into the refrigeration system. When the liquid ammonia enters the flash drum, the liquid ammonia is captured and sent to the ammonia storage tank. The vapor is captured; its pressure is increased; then it is cooled resulting in its liquefaction. All liquid ammonia is sent to an atmospheric storage tank. Each ammonia plant has one atmospheric storage tank. The capacity of the Plant 1 storage tank is 30,000 tons; the capacity of the Plant 4 storage tank is 50,000 tons. A majority of the ammonia product transported off site is shipped via barge or ship. (Unocal 1993)

## 2.2 Urea Plants

Urea is manufactured at Plants 2 and 5 from the carbon dioxide and ammonia generated at the on-site ammonia plants. The process of manufacturing urea is slightly different at each plant but involves the same general steps:

1. Compression of ammonia and $CO_2$;
2. High-pressure synthesis;
3. Crystallization and/or evaporation; and,
4. Granulation. (Unocal 1993)

### 2.2.1 Plant 2

Plant 2 is capable of manufacturing up to 1,500 tons of urea prills per day. The process begins by compressing $CO_2$ gas from the ammonia plants. The $CO_2$ is compressed from a pressure of 12 psig to 3,400 psig through a series of booster compressors. Liquid ammonia from atmospheric storage also is pressurized through a series of pumps to a pressure of 3,200 psig and heated to a temperature of 225 °F. (Unocal 1993)

The pressurized liquid ammonia, $CO_2$ gas, and recycled ammonium carbamate enter the Urea Reactor. A spontaneous reaction occurs forming ammonium carbamate that requires dehydration to form urea. The reaction converts approximately 72% of the incoming ammonia and $CO_2$. The urea, unreacted carbamate, and water from the Urea Reactor undergo a reduction in pressure followed by temperature elevation in a series of three decomposers. Lowering the pressure and heating this process stream decomposes the carbamate and boils off unconverted ammonia, $CO_2$, and water. These products along with carbamate that was not decomposed are recycled back into the process. (Unocal 1993)

The product exiting the separators is 69% urea and 31% water. This product stream is sent to the Crystallizer where it is dehydrated. Once the urea is dehydrated, it is sent to the top of the Prill Tower. The urea crystals are melted, screened, then dumped into buckets. The buckets are spun and molten urea is thrown out of small holes in the buckets, forming droplets as it falls to the bottom of the Prill Tower. The prills are conveyed to a large urea storage warehouse on a conveyor belt. Urea is shipped off site via barge or ship. (Unocal 1993)

### 2.2.2 Plant 5

Plant 5 is capable of producing 1,900 pounds of urea prills per day. The process of urea manufacture in this plant begins much the same way as it does in Plant 2 with pressurizing the $CO_2$ gas and liquid ammonia. In this plant, the ammonia and $CO_2$ are raised to a pressure of 2,250 psig. Once the liquid ammonia and $CO_2$ gas reach the designated temperature and pressure, they enter the reactor. In the reactor, the ammonia and $CO_2$ react to form ammonium carbamate. The heat of the reaction helps to drive off the water and form urea. (Unocal 1993)

The process stream from this reaction consists of urea, water, ammonia, and $CO_2$. This process stream is sent to a separator where the pressure is dropped to release the ammonia and $CO_2$. The ammonia and $CO_2$ are condensed to form carbamate which is recycled back to the reactor. The urea and water mixture are sent to an evaporator to remove the water. After removal of water, the process solution, consisting of 99% urea, is sent to a granulator. In the granulator, ambient air cools the solution as prills form. The prills then are conveyed to a storage warehouse until they are shipped off site via ship or barge. (Unocal 1993)

# 3. REGULATORY CRITERIA

The primary purpose of CERCLA and Emergency Planning Community Right-to-Know Act (EPCRA) Release Reporting Requirements is to notify government officials of potentially dangerous hazardous substance releases that may require a timely response action to prevent or mitigate damage to public health or welfare or the environment. Continuous release reporting is established under CERCLA Section 103(f)(2) [40 CFR 302.8] and provides for a special reduced reporting option for releases that are "continuous" and "stable in quantity and rate". (EPA 1997)

A continuous release is defined as a release that occurs without interruption or abatement or that is routine, anticipated, and intermittent and incidental to normal operations or treatment processes [40 CFR 302.8(b)]. A release that is stable in quantity and rate is a release that is predictable and regular in amount and rate of emission [40 CFR 302.8(b)]. In order for a release to qualify for reduced reporting under the CERCLA Section 103(f)(2), the facility needs to demonstrate that release(s) meet the aforementioned definitions. A facility can use release data, engineering estimates, knowledge or operating procedures, or best professional judgement to establish the continuity and stability of the release, internally. Once this is done, the facility then establishes officially that the release is continuous through a series of notifications to the National Response Center (NRC), the State Emergency Response Commission (SERC), and the Local Emergency Planning Committee (LEPC). (EPA 1997)

Per the 1997 EPA guidance, *Reporting Requirements for Continuous Releases of Hazardous Substances, A Guide for Facilities on Compliance*:

> A continuous release may be a release that occurs 24 hours a day (e.g., a radon release from a stockpile) or a release that occurs during a certain process (e.g., benzene released during the production of polymers) or a release that occurs intermittently (e.g., the release of a hazardous substance from a tank vent each time the tank is filled).
>
> Some releases resulting from malfunctions may also qualify for reduced reporting as continuous releases under Section 103(f)(2) if they are incidental to normal plant operations or treatment

processes, are stable in quantity and rate, and either (1) occur without interruption or abatement or (2) are routine, anticipated, and intermittent.

The determinative question of whether any release, including a malfunction, qualifies for reporting under Section 103(f)(2) is whether the release satisfies the definitions of "continuous" and "stable in quantity and rate." (EPA 1997)

Under 40 CFR 302.8(b), the definition of *continuous* is as follows: A continuous release is a release that occurs without interruption or abatement or that is routine, anticipated, and intermittent and incidental to normal operations or treatment processes.

Under 40 CFR 302.8(b), the definition of *stable in quantity and rate* is as follows: A release that is stable in quantity and rate is a release that is predictable and regular in amount and rate of emission.

As of June 18, 2002, the Agrium KNO facility reported a total of 34 ammonia releases as continuous and stable in quantity and rate. Additionally, during February 2002, Agrium reported a temporary continuous source, which brought the total number of continuous sources to 35. This source[1] was eliminated by the end of February 2002. Excluding the intermittent releases and assuming the average amount of ammonia is released daily from the continuous sources, the total amount of ammonia released to air from the KNO facility is 3.1 tons per day (tpd) or 2.3 million pounds per year. Assuming the upper bound on all releases, including the intermittent releases, occurs on a daily basis, then the amount of ammonia released daily is 30.4 tpd. This number is exceptionally high because it assumes that all of the intermittent releases occur daily, which is unlikely. Taking into account intermittent releases, a more realistic upper bound was calculated by Agrium to be 13.7 tpd or 10 million pounds per year. Agrium has calculated the lower range of their daily ammonia releases to be 1 tpd or 765,000 pounds per year. (Agrium 2002)

[1] This source, Plant 2 Ammonia Preheater, F-434, is discussed in Section 5.6.1.

# 4. SCOPE AND INSPECTION APPROACH

The EPA selected the Agrium KNO facility for a continuous release inspection based on the large amount of ammonia reportedly being released from the facility annually.

The inspection team comprised of one member from the EPA's START-2 personnel. The investigation consisted of a review of the facility's continuous release records and reports and an on-site visit of the Agrium KNO facility between June 25 and June 26, 2002, to review the operational areas identified in the release reports. The START-2 focused the investigation on continuous releases whose maximum daily release quantity exceeds the reportable quantity (RQ) for anhydrous ammonia[2], but the START-2 did not include fugitive emission sources as part of the investigation. During the on-site visit, the START-2 reviewed the processes, interviewed personnel involved with continuous release reporting and operating the processes, toured the facility, and obtained supporting documentation for the continuous releases reported in Agrium's CR-ERNS report.

A critical part of the continuous release inspection was the interviews with Agrium personnel involved with continuous release reporting. Agrium personnel interviewed during the investigation included: Denise Newbould, Environment, Health and Safety Superintendent; and Michelle Gryzbowski, Environmental Engineer.

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[2] The RQ for anhydrous ammonia is 100 pounds per day.

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# 5. SUMMARY OF RELEASES & FINDINGS

The START-2 reviewed all of the releases reported in Agrium's CR-ERNS report with the exception of those releases whose upper bound was less than the RQ and those releases involving fugitive emissions. This section presents information about each release over the RQ. Information included in this section includes:

- Source name;
- Type of source (continuous or intermittent);
- Chemical(s) and quantity released;
- Description of the release; and
- Additional information regarding the continuous nature of the release.

## 5.1 PLANT 1 RELEASES

Agrium reports a total of four continuous releases from Plant 1. All four releases involve the release of anhydrous ammonia to air; however, only one release exceeds the RQ for ammonia and is discussed in this section.

### 5.1.1 Plant 1 Wet Reformed Gas Vent, F-130

The F-130 Wet Reformed Gas Vent is an intermittent source that releases anhydrous ammonia to the air during startup of the plant. Agrium estimates the upper bound of the amount released per day during a plant startup as 6,200 pounds per day (ppd). A lower bound on the release rate is not reported for this source.

During startup of Ammonia Plant 1, steam and air are introduced into the primary and secondary reformers to heat them up to the process temperature of 1,350 °F. The shift convertors also are being heated at this time. While the steam and air are heating up the reformer, some of the gases are being reformed into CO, $CO_2$, nitrogen and hydrogen. Some of the nitrogen and hydrogen formed during startup are combining spontaneously to form ammonia. However, because the reformer is not at its normal operating temperature, the amount of reformed gas generated during this time is not sufficient to send on to the next step in the process. Therefore, the reformed gas, steam, air, and the small amount of ammonia generated during startup is discharged to the atmosphere through the F-130 Wet Reformed Gas Vent. The gases are discharged to the atmosphere to prevent the buildup of pressure in the reformer. During normal plant operation, pressure in the reformer is regulated by sending the reformed gas on to shift conversion process. Venting during a hot plant startup is estimated to last up to six hours. Venting during a cold plant startup can take place anywhere between 12 and 24 hours.

The release rate reported in Agrium's CR-ERNS report was calculated using the Simulation Sciences Computer Model (Pro II Version 5.5). The program uses complicated algorithms that take into account the temperature, pressure, flow rates, and other process variables to determine te amount of ammonia vented during a plant startup.

Ammonia emissions from the F-130 Wet Reformed Gas Vent occur during a plant startup, which is a planned and routine event. Because ammonia emissions from this source typically are zero, exhaust from the F-130 Wet Reformed Gas Vent are vented to the atmosphere instead of being directed to a flare. However, during a plant startup, ammonia emissions from this source are released to the atmosphere at a rate that is predictable. Based on this information, the F-130 Wet Reformed Gas Vent source can be considered a continuous source.

## 5.2 PLANT 2 RELEASES

Agrium reports a total of ten continuous releases from Plant 2. All ten releases involve the release of anhydrous ammonia to air. Of the ten continuous releases reported, two of the releases do not exceed the RQ for anhydrous ammonia. Eight of the continuous releases from Plant 2 do exceed the RQ and are discussed in this section.

### 5.2.1 Plant 2 Prill Tower, P-406

The P-406 Prill Tower is a continuous source of anhydrous ammonia emissions. The ammonia emissions are the result of producing urea prills. Agrium reports the lower bound of the total amount released on a daily basis as 700 ppd. Agrium reports the upper bound of the daily release rate as 1,200 ppd.

In Plant 2, urea prills are formed by melting urea crystals and pouring the molten urea into spinning, perforated buckets located at the top of the P-406 Prill Tower. The molten urea entering the spinning bucket is thrown out of the small holes forming droplets. The droplets solidify as they fall 170 feet to the bottom of the tower. Although most of the ammonia has been removed from the urea by this step in the process, some residual ammonia does remain. As the urea prills fall to the floor of the P-406 Prill Tower, some of the residual ammonia vaporizes from the product. The P-406 Prill Tower is open to the atmosphere and does not incorporate equipment or processes to capture ammonia vapors.

In October 1993, a source test was performed on the P-406 Prill Tower. AmTest Alaska collected samples from the eight exhaust ducts at the top of the prill tower and determined that approximately 1,200 pounds per day of ammonia is released from this source (AmTest 1993). A copy of the source test is provided with the supporting documentation in Appendix B.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. Because the P-406 Prill Tower is open to the atmosphere, it is impossible to capture the ammonia emissions generated by this source. According to the source test performed on P-406 Prill Tower in 1993, the ammonia emission rate is stable in quantity and rate. The amount of ammonia released from this source depends on the production rate. The production rate in Plant 2 at the time of the source test was 58 tons per hour, or 1,392 tons per day. The maximum production rate in Plant 2 is 1,500 tons per day. If the urea production rate is at its maximum, the ammonia emissions from this source will be at their highest. Likewise, if Plant 2 is shut down for a turnaround, emissions from this source are zero. Based on this information, the emissions from the P-406 Prill Tower can be considered a continuous source.

### 5.2.2 Plant 2 Atomospheric Absorber, D-405

The D-405 Atmospheric Absorber is a intermittent source of anhydrous ammonia emissions; however, when it does release ammonia, the emissions are continuous. The release occurs when the absorber is shut down for maintenance. Agrium reports the upper bound of the daily release rate as 1,000 ppd. No lower bound is reported for this source.

The D-405 Atmospheric Absorber strips ammonia released from the F-446 Vent Condenser Hotwell Tank, which is associated with the separation process. Process air from this vent is passed through the atmospheric absorber to remove residual ammonia. Because very little ammonia remains in the process air from this particular vent, a majority of the ammonia normally is removed by the absorber. However, when the absorber is down for repair, it is not removing any ammonia. Instead, the ammonia from this tank vent is released to the atmosphere during maintenance. The release rate reported in Agrium's CR-ERNS is an engineering estimate based on flow rate to the tank, an ammonia flash calculation, and tank venting associated with breathing and working losses.

Ammonia emissions from the D-405 Atmospheric Absorber occur during maintenance, which is a planned and routine event. Because ammonia emissions from this source typically are zero, exhaust from the absorber are vented to the atmosphere instead of being directed to the small flare. However, when the D-405 Atmospheric Absorber is down for maintenance, the ammonia emissions are released to the atmosphere and the rate from this source is predictable. Based on this information, the D-405 Atmospheric Absorber source can be considered a continuous source.

### 5.2.3 Plant 2 Tank Vent Scrubber, D-406

The D-406 Tank Vent Scrubber is a intermittent source of anhydrous ammonia emissions; however, when it does release ammonia, the emissions are continuous. The release occurs when the scrubber is shut down for maintenance. Agrium reports the upper bound of the daily release rate as 1,000 ppd. No lower bound is reported for this source.

The D-406 Tank Vent Scrubber removes ammonia vapors from the F-434 Effluent Accumulation Tank and the F-467 Hydrolizer Feed Tank. Similar to the D-405 Atmospheric Absorber, the amount of ammonia entering this scrubber is very low so a majority of it is removed during normal operation. When the scrubber is down for maintenance, ammonia is no longer being removed but being released to the atmosphere. The release rate reported in Agrium's CR-ERNS is an engineering estimate based on flow rate to the tank, an ammonia flash calculation, and tank venting associated with breathing and working losses.

Ammonia emissions from the D-406 Tank Vent Scrubber occur during maintenance, which is a planned and routine event. Because ammonia emissions from this source typically are zero, exhaust from the scrubber are vented to the atmosphere instead of directed to the small flare. However, when the D-406 Tank Vent Scrubber is down for maintenance, the ammonia emissions are released to the atmosphere continuously and the rate from this source is predictable. Based on this information, the D-406 Tank Vent Scrubber source can be considered a continuous source.

### 5.2.4 Plant 2 Vent Scrubber, D-407

The D-407 Vent Scrubber is a continuous source of anhydrous ammonia emissions. The release occurs as a result of urea prill production. Agrium reports the upper bound of the daily release rate as 180 ppd. No lower bound is reported for this source.

In the Urea Reactor, ammonia and carbon dioxide spontaneously combine to form urea. The reaction is about 72% complete. The remaining solution consists of the unconverted ammonia, $CO_2$, and carbamate. This solution is sent to the decomposition and absorption section for recovery of the unreacted raw materials. In order to separate the ammonia and the $CO_2$ and to breakdown the carbamate, the pressure must be lowered. As the pressure is lowered, the ammonia boils off and is captured by absorbers to be recycled back into the urea process. The D-407 Vent Scrubber removes ammonia from the gas stream resulting from this separation process. Because the removal efficiency of this scrubber is not 100 percent, ammonia is released to the atmosphere continuously.

Agrium analyzes the emissions from the D-407 Vent Scrubber for ammonia every two weeks. Agrium provided the START-2 with all of the estimated emission rates from January 11, 2001, to June 27, 2002 (Appendix B). The emission rates are calculated from the analytical results of the emission samples. According to the data from the past year and a half, the average amount of ammonia released to the atmosphere from the D-407 Vent Scrubber is 28 ppd. The maximum amount of ammonia released to the air was calculated by Agrium as 112 ppd.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The emissions from the D-407 Vent Scrubber are sampled on a bi-weekly basis. The analytical results of these samples between January 2001 and July 2002 indicate that the ammonia emissions from this source are relatively stable in quantity in rate. Based on this information, the emissions from the D-407 Vent Scrubber meet the definition of a continuous source.

### 5.2.5 Plant 2 Vent Scrubber, D-408

The D-408 Vent Scrubber is a continuous source of anhydrous ammonia emissions. The release occurs as a result of urea prill production. Agrium reports the upper bound of the daily release rate as 100 ppd. No lower bound is reported for this source.

The D-408 Vent Scrubber is used to remove ammonia from the inert gas stream that results from injecting air into the $CO_2$ stream sent to the urea plants. Adding air to the $CO_2$ gas stream helps passivate the stainless steel of the urea reactor and other high-pressure vessels and piping. The oxygen in the air helps build up a passive oxide layer on the stainless steel which prevents corrosion. The D-408 Vent Scrubber was installed to remove the ammonia that is picked up by the inert gas stream as it travels through the urea plant. The D-408 Vent Scrubber was designed to remove 99% of the ammonia in this gas stream.

Agrium analyzes the emissions from the D-408 Vent Scrubber for ammonia every two weeks. Agrium provided the START-2 with all of the estimated emission rates from January 11, 2001, to June 27, 2002 (Appendix B). The emission rates are calculated from the analytical results of the emission samples. According to the data from the past year and a half, the average amount of ammonia released to the atmosphere from the D-408 Vent Scrubber is 15 ppd. The maximum amount of ammonia released to the air was calculated by Agrium as 46 ppd.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The emissions from the D-408 Vent Scrubber are sampled on a bi-weekly basis. The analytical results of these samples between January 2001 and July 2002 indicate that the ammonia emissions from this source are relatively stable in quantity in rate. Based on this information, the emissions from the D-408 Vent Scrubber meet the definition of a continuous source.

### 5.2.6 Plant 2 Cooling Tower, E-611

The E-611 Cooling Tower is an intermittent source of ammonia emissions and occurs as a result of a Process Condensate Stripper outage. Process Condensate Stripper outages occur once every four years during the Plant 4 turnaround. The upper bound of the daily release rate is reported by Agrium as 6,200 ppd. No lower bound is reported for this source.

Cooling water is used throughout all processes to maintain the proper temperatures and pressures throughout the system. The E-611 Cooling Tower receives waste steam and process cooling waters from Plants 1 and 2. The E-611 Cooling Tower is an open recirculation system that uses ambient air to cool the water. Fans on top of the cooling tower pull air countercurrent to the flow of water. Before process water reaches the cooling tower, it typically passes through the Process Condensate Stripper to remove ammonia that was picked up by the process condensate waters. Normally, the Process Condensate Stripper removes all of the ammonia contained in process condensate water. Process condensate water typically contains about 0.1% ammonia (Grzybowski 2002).

The Agrium KNO facility has only one Process Condensate Stripper, which is located in Plant 4. The Process Condensate Stripper treats process condensate waters from Plant 1 and Plant 4. Once every four years, Plant 4 is shut down for a plant turnaround. This means that the Process Condensate Stripper also is shut down. Plant 1 typically is not shut down during a Plant 4 turnaround and is therefore generating process condensate water. Because the Process Condensate Stripper is not operating during a Plant 4 turnaround, it cannot treat the process condensate water from Plant 1. Therefore, the process condensate water from Plant 1 is redirected, untreated, to either the E-611 (Plant 2) Cooling Tower or the E-711 (Plant 5) Cooling Tower. During the Plant 4 turnaround, the Process Condensate Stripper typically is shut down for three days. During this time the cooling tower receiving the untreated Plant 1 process condensate water is releasing ammonia (Agrium 1999).

Agrium provided the START-2 with calculations for their routine and continuous ammonia release sources related to process condensate water (Appendix B). The process and instrumentation diagram (P&ID) for the Process Condensate Stripper indicates that the molar flow rate of ammonia in the process condensate stream to the Process Condensate Stripper is 30.49 pound-moles per hour. This is the stream that is redirected to either the E-611 (Plant 2) or E-711 (Plant 5) Cooling Tower during a Plant 4 turnaround. Using this molar flow rate, Agrium calculates the amount of ammonia released from a cooling tower during a Process Condensate Stripper outage as 6,200 ppd (Appendix B).

Ammonia emissions from the E-611 Cooling Tower occur during a Plant 4 turnaround, which is a planned and routine event. Ammonia emissions from this source typically are zero so the exhaust from the E-611 Cooling Tower is vented to the atmosphere instead of directed to a flare. However, when the Process Condensate Stripper is shut down during the Plant 4 turnaround, the ammonia emissions are released to the atmosphere continuously and at a rate that is predictable. It should be noted, however, that if the decision is made to direct process condensate water to the E-711 (Plant 5) Cooling Tower during a Plant 4 turnaround, then emissions from this source are zero. Based on this information, the E-611 Cooling Tower source can be considered continuous.

### 5.2.7 Plant 1 & 2 Vent/Flare Stack, B-402

The B-402 Vent/Flare Stack is a continuous source of anhydrous ammonia emissions. The source is a result of ammonia and urea production. Agrium reports the upper bound of the daily release rate as 4,700 ppd. Agrium reports the lower bound of the daily release rate as 6 ppd.

Plant 2 has two flares: a large flare for burning ammonia associated with emergencies and large process upsets and a small flare for combusting ammonia resulting from normal operations. The B-402 Vent/Flare Stack is the small flare that burns ammonia emissions from normal process operations associated with Plants 1 and 2. The B-402 Vent/Flare Stack burns 99.5% of the ammonia vapors that pass through it and discharges the uncombusted ammonia to the atmosphere. The ammonia entering the flare comes from tank vents, pressure relief valves, and other equipment that discharge ammonia. The exhaust from a majority of the tank vents and pressure relief valves in Plants 1 and 2 are directed to this flare. The flare is sized to handle the emissions from normal operations and small upsets. Ammonia from larger process upsets is sent to the emergency flare discussed in Section 5.2.8.

Agrium provided the START-2 with spreadsheet calculations for their routine and continuous ammonia release sources related to the B-402 Vent/Flare Stack. This spreadsheet is provided in Appendix B. The spreadsheet presents the amount of ammonia burned by the small flare on a monthly basis from January 2001 until July 2002. Based on the totalizer information, the average amount of ammonia burned by the B-402 Vent/Flare Stack on a daily basis is 761 ppd. Assuming that the flare's combustion efficiency is 99.5%, the average amount of ammonia released from this source is calculated to be about 4 ppd. Based on the monthly averages recorded between January 2001 and July 2002, Agrium calculated the upper bound of the daily release rate from this source as 3,850 ppd. Agrium assumes that the upper bound of the reported daily release rate will be actualized when the B-402 Vent/Flare Stack is down for repair. At this time none of the ammonia passing through the flare is being combusted. To conservatively estimate the upper bound of the amount released during this scenario, Agrium used the maximum recorded amount of ammonia passing through the small flare. The upper and lower bounds calculated using the spreadsheet fall within the upper and lower bounds reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The amount of ammonia entering the B-402 Vent/Flare Stack is continuously monitored, making the emission rate from this source easy to quantify. Based on the information provided by Agrium, it appears that the B-402 Vent/Flare Stack meets the definition of a continuous source.

### 5.2.8 Plant 1 & 2 Emergency Flare, B-403

The B-403 Emergency Flare is a continuous source of anhydrous ammonia emissions. Releases from this source occur as leakage from the valve that separates the B-403 Emergency Flare from the B-402 Vent/Flare Stack. Agrium reports the upper bound of the release rate as 700 ppd. No lower bound is reported for this source.

The B-403 Emergency Flare is designed to accommodate flow rates greater than 10,000 pounds per minute whereas the B-402 Vent/Flare Stack is designed to handle flow rates less than 10,000 pounds per minute. Therefore, when there is a process upset that results in a gas stream flow rate of greater than 10,000 pounds per minute, the gas stream is diverted immediately to the B-403 Emergency Flare. The emergency flare is separated from the small flare by a buckle pin valve.

The design of the buckle pin valve is such that the valve can open immediately in the event of a process upset or a pressure relief valve lifting that the small flare cannot handle. One of the tradeoffs of the design is that in order for the valve to open so rapidly, the valve seat cannot be completely sealed. Because the valve seat in the buckle pin valve is not completely sealed, some of the ammonia entering the small flare escapes through the gap in the seal to the emergency flare. Ammonia passing through the emergency flare during non-emergency operations is not combusted before being discharged to the atmosphere.

Agrium provided the START-2 with spreadsheet calculations for their routine and continuous ammonia release sources related to the B-403 Emergency Flare. The spreadsheet is provided as supporting documentation in Appendix B. Agrium analyzes the emissions from the B-403 Emergency Flare on a bi-weekly basis. From this data, Agrium calculates the average tons of ammonia released per day from this source. Agrium provided the START-2 with the analytical data from January 2001 to mid-June 2002. Based on this data, Agrium estimates the average amount of ammonia released from this source daily as 381 ppd. The maximum amount of ammonia released from this source between January 2001 and mid-June 2002, is recorded as 1,280 pounds per day. This amount is greater than the upper bound reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. Emissions from the B-403 Emergency Flare are monitored on a bi-weekly basis. Analysis of the emissions indicate that the amount of ammonia released from this source is relatively stable in quantity in rate. Based on the information provided by Agrium, it appears that the B-403 Emergency Flare meets the definition of a continuous source.

## 5.3 PLANT 3 RELEASES

Agrium reports one continuous release from Plant 3. The release exceeds the RQ and is discussed in this section.

### 5.3.1 Plant 3 Oil/Water Separator, F-1715

The F-1715 Oil/Water Separator is an intermittent source of ammonia emissions. Ammonia is released as a result of maintenance activities. Agrium reports the upper bound of the release rate as 1,500 ppd. No lower bound is reported for this source.

Oily water is generated as a result of production and maintenance activities. Ammonia typically becomes entrained in the oily water, so it is sent to the F-1715 Oil/Water Separator for treatment. The F-1715 Oil/Water Separator is heated to enhance the separation of oil and water. As a result of heating the tank, the ammonia contained in the oil evaporates and is released to the air.

According to Agrium, the volume of the F-1715 Oil/Water Separator is 10,000 gallons and typically is 50% full, of which, 10% to 20% is oil and 0% to 3% is ammonia. The release rate was calculated by multiplying the tank capacity by the maximum concentration of ammonia in the water and the density of ammonia.

Ammonia emissions from the F-1715 Oil/Water Separator occur when oily water containing ammonia is generated which only happens when maintenance work such as a tank cleaning takes place. Because cleaning tanks are planned and routine events and the rate of release from this source is predictable, the F-1715 Oil/Water Separator meets the definition of a continuous source.

## 5.4 PLANT 4 RELEASES

Agrium reports a total of six continuous releases from Plant 4. All six releases involve the release of anhydrous ammonia to air. Of the six continuous releases reported, two of the releases do not exceed the RQ for anhydrous ammonia. Four of the continuous releases from Plant 4 do exceed the RQ, and they are discussed in this section.

### 5.4.1 Plant 4 Process Condensate Vent, F-263

The F-263 Process Condensate Vent is a continuous source of ammonia emissions. The source is a result of ammonia production. Agrium reports both the upper and lower bound of the daily release rate as 120 ppd.

The F-263 Process Condensate Collection Tank receives process condensate from the three water knockout drums in both ammonia plants. The pressure of the F-263 Process Condensate Collection Tank must be high enough to feed the Process Condensate Stripper feed pumps but low enough for the water to flow from the water knockouts to F-263 Process Condensate Collection Tank. Entrained and dissolved inert gases (mostly H2, N2 and CO2) in any of the feed streams eventually must be vented or the pressure would rise in the F-263 Process Condensate Collection Tank which would result in not being able to drain another vessel. Agrium expects the amount of ammonia in this inert gas stream to be low and estimates the amount released from this source to be 120 pounds per day.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. Based on the information provided by Agrium, it appears that the F-263 Process Condensate Vent meets the definition of a continuous source.

### 5.4.2 Plant 4 Hydrogen Vent Stack, C-200

The C-200 Hydrogen Vent Stack is an intermittent source of ammonia emissions. Ammonia is released from this source during startup of the ammonia plant. Agrium reports the upper bound of the daily release rate as 1,000 ppd. No lower bound is reported for this source.

During startup of Ammonia Plant 4, steam and air are introduced into the primary and secondary reformers to heat them up to the process temperature of 1,350 °F. While the steam and air are heating up the reformer, some of the gases are being reformed into CO, $CO_2$, nitrogen and hydrogen. Some of the nitrogen and hydrogen formed during startup are combining spontaneously to form ammonia. However, because the reformer is not at its normal operating temperature, the amount of reformed gas generated during this time is not enough to send on to the next step in the process. Therefore, the reformed gas, steam, air, and the small amount of ammonia generated during startup are discharged to the atmosphere through the C-200 Hydrogen Vent Stack. The gases are discharged to the atmosphere to prevent the buildup of pressure in the reformer. During normal plant operation, pressure in the reformer is regulated by sending the reformed gas on to shift conversion process.

The release rate reported in Agrium's CR-ERNS report was calculated using the Simulation Sciences Computer Model (Pro II Version 5.5). The program uses complicated algorithms that take into account the temperature, pressure, flow rates, and other process variables to determine te amount of ammonia vented during a plant startup.

Ammonia emissions from this source occur as a result of starting up Plant 4, which is a planned and routine event. Emissions from this source typically are zero since this vent is used only during a startup. During startup the ammonia emissions are released to the atmosphere and the rate from this source is predictable. Based on this information, the C-200 Hydrogen Vent Stack source can be considered a continuous source.

### 5.4.3 Plant 4 Steam Knock-out Drum, H-260

The H-260 Steam Knock-out Drum is an intermittent source of ammonia emissions. Ammonia is released from this source during a plant during a shut down. Agrium reports the upper bound of the daily release rate as 6,200 ppd. No lower bound is reported for this source.

The H-260 Steam Knock-out Drum is part of the Process Condensate Stripper located in Plant 4. The Agrium KNO facility has only one Process Condensate Stripper. The Process Condensate Stripper treats process condensate waters from Plant 1 and Plant 4. All water used in Plants 1 and 4 has some amount of ammonia entrained in it.

Prior to steam entering the Process Condensate Stripper, it is passed through the H-260 Steam Knock-out Drum to separate the gaseous phase from the liquid phase. When Plant 4 is operating, the steam from the knock-out drum typically is sent to the Plant 4 reformer to maintain its operating temperature. When Plant 4 is shut down for a turnaround, which happens once every four years, the steam entering the knock-out drum is discharged to the atmosphere. Steam entering the knock-out drum comes from Plant 1 since it is still operating during a Plant 4 turnaround. Because the steam from Plant 1 has ammonia entrained in it, ammonia is released from the H-260 Steam Knock-out Drum. Agrium estimates the duration of the release from the H-260 Steam Knock-out Drum source to be a total of 30 days[3].

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[3] During a plant turnaround, the reformer is not operating for the duration of the turnaround, which typically lasts 30 days. However, the Process Condensate Stripper is only shut down for three days to perform maintenance and inspection activities during a plant turnaround. This explains the discrepancy in release durations

Agrium provided the START-2 with calculations for their routine and continuous ammonia release sources related to the process condensate (Appendix B). According to the P&ID for the Process Condensate Stripper, the molar flow rate of ammonia entering the H-260 Steam Knock-out Drum from Plant 1 is 15.37 pound-moles per hour. Using this molar flow rate, Agrium determined that the mass of ammonia released from the H-260 Steam Knock-out Drum during a Plant 4 turnaround is 6,200 ppd (Appendix B).

Ammonia emissions from the H-260 Steam Knock-out Drum occur during a Plant 4 turnaround, which is a planned and routine event. Ammonia emissions from this source typically are zero because the steam entering the H-260 Steam Knock-out Drum typically is directed to the reformer instead of discharged to the atmosphere. However, when the reformer is not operating, the steam is released to the atmosphere continuously and at a rate that is predictable. Based on this information, the H-260 Steam Knock-out Drum source can be considered continuous.

### 5.4.4 Plant 4 Ammonia Drain Tank, F-287

The F-287 Ammonia Drain Tank is an intermittent source of ammonia emissions. Ammonia is released from this source during pump maintenance work. Agrium reports the upper bound of the daily release rate as 165 ppd. A lower bound for this source is not reported.

In order to perform maintenance on pumps around Plant 4, piping leading to and from the pump must be blocked off and drained. The F-287 Ammonia Drain Tank is used to hold the solution drained from those pipes that need to be blocked off for pump maintenance activities. The percentage of ammonia in the solution drained to this tank ranges from zero to ninety percent. The solutions in the tank are removed from the tank with a vacuum truck, typically within 24 hours. While the tank is waiting to be emptied, ammonia vapors are being generated. Ammonia vapors from this tank typically are sent to the B-502 Vent/Flare Stack in Plant 5 and burned; however, if the B-501 Emergency Flare has been activated while the F-287 Ammonia Drain Tank is waiting to be drained, the vapors will be vented to the atmosphere.

When the emergency flare is activated, the small flare is inoperable. The emergency flare is designed such that it cannot accept large amounts of oxygen. If the flare piping has oxygen and fuel, it

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between sources associated with Plant 4 turnarounds.

becomes an explosive mixture with the flare as the ignition source. Once ignited, the flame propagates back into the vent piping with possible significant damage to the piping or connected vessels. Because Agrium's vents can contain hydrogen, it is especially important that oxygen is kept out of the vent headers.

When the emergency flare is activated, it draws a large amount of vacuum pressure. The vacuum pressure drawn by the emergency flare is high enough to cause the drain tanks vacuum breaker to lift. If the drain tank was connected to the emergency flare and the emergency flare was activated, the vapors from the drain tank would be sucked into the emergency flare[4]. The vapor stream from the F-287 Ammonia Drain Tank contains a sufficient amount of oxygen that precludes it from being sent to the emergency flare due to safety concerns.

According to Agrium, the F-287 Ammonia Drain Tank is used about once a week. However, the frequency of the B-501 Emergency Flare being activated while the F-287 Ammonia Drain Tank is in use is estimated by Agrium to be no more than 20 times per year. According to Agrium, the capacity of the F-287 Ammonia Drain Tank is 2,000 gallons. Assuming that the amount of ammonia in the tank is 1%, the tank capacity is multiplied by the weight percent ammonia in the liquid and the density of ammonia. Based on this calculation, Agrium estimates a total of 165 pounds of ammonia released in the event that the emergency flare is activated while the tank is being emptied.

Based on the information provided by Agrium, it is unknown if the F-287 Ammonia Drain Tank can be considered a continuous source. A release occurs when the tank is being emptied, which is a planned and routine event, meeting one part of the definition of a continuous source. However, the emergency flare being activated during the process of emptying the tank is not predictable because emergency flare activation happens during process upsets, which are inherently unpredictable. Although the rate of emission is predictable, the rate of occurrence is not, which calls into question whether or not this source meets the definition of continuous.

## 5.5 PLANT 5 RELEASES

Agrium reports a total of eight continuous releases from Plant 5. All eight releases involve the release of anhydrous ammonia to air. Of the eight continuous releases reported, one of the releases does

[4] It should be noted that while the emergency flare is activated, the small flare in not operational.

not exceed the RQ for anhydrous ammonia. Seven of the continuous releases from Plant 5 do exceed the RQ and they are discussed in this section.

### 5.5.1 Plant 5 Granulator Scrubbers, C-560A&B

The C-560A&B Granulator Scrubbers are a continuous source of ammonia emissions. Ammonia is released as a result of urea granule production. Agrium reports the upper bound of ammonia released on a daily basis as 1,100 ppd. Agrium reports the lower bound of ammonia released on a daily basis as 680 ppd.

The end product manufactured at Plant 5 is urea granules. The granulation section of Plant 5 consists of four rotating drums. A solution consisting of 99% Urea is sprayed into the drums over a bed of recycled product. As the beds rotate, air is being forced through the granulator to cool the liquid urea and form granules. The exhaust from the granulator contains particulate matter which needs to be removed prior to discharging it to the atmosphere. To remove the particulate matter, the exhaust from the granulator is sent to the C-560A&B Granulator Scrubbers. Ammonia is still evaporating from the urea as it is sprayed into the granulator. Ammonia also is evaporating from urea particles as it enters the C-560A&B Granulator Scrubbers. The exhaust from the C-560A&B Granulator Scrubbers is discharged directly to the atmosphere. Because the exhaust contains ammonia, the C-560A&B Granulator Scrubbers are therefore a source of ammonia emissions.

In October 1993, a source test was performed on the C-560A&B Granulator Scrubbers. The source test was conducted by AmTest Alaska to determine the urea emission rate from this source. As part of the test, the stack gas flow rate was determined. In 1999, Agrium collected an air sample from the C-560A&B Granulator Scrubbers and determined that the concentration of ammonia in the emissions from this source was 57 parts per million (ppm). Using this ammonia concentration and the stack gas flow rate, Agrium calculated the average amount of ammonia discharged from this source to be 642 ppd. Agrium calculated the upper bound of the ammonia released from this source by assuming a concentration of 100 ppm in the stack gas. The upper bound of the ammonia released from the C-560A&B Granulator Scrubbers was calculated to be 1,100 ppd. The calculations and test results for the C-560A&B Granulator Scrubbers is provided in Appendix B.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. Analysis of the emissions indicate that the amount of ammonia released from this source is relatively stable in quantity in rate. Based on the information provided by Agrium, it appears that the C-560A&B Granulator Scrubbers meet the definition of a continuous source.

### 5.5.2 Plant 5 Atmospheric Absorber, D-512/D-515

The D-512/D-515 Atmospheric Absorber is a continuous source of ammonia emissions. Ammonia is released as a result of urea production. Agrium reports the upper bound of ammonia released on a daily basis as 200 ppd. A lower bound for this source is not reported.

This series of absorbers collects the inert gases and process gases vented at the front end of the urea manufacturing process and removes most of the ammonia carried by these gases before being discharged to the atmosphere. Because the absorbers are not 100% efficient at removing ammonia, ammonia is released to the atmosphere from this source on a continuous basis.

Agrium provided the START-2 with spreadsheet calculations for their routine and continuous ammonia release sources related to the D-512/D-515 Atmospheric Absorber. Agrium analyzes the emissions from this source on a bi-weekly basis. The analytical results are used to determine the average and maximum amount of ammonia released from this source. Using the analytical data collected between January 2001 and mid-June 2002, Agrium calculated the average amount of ammonia released from the D-512/D-515 Atmospheric Absorber as 16 ppd. The maximum amount of ammonia released from the D-512/D-515 Atmospheric Absorber, based on the analytical data, was calculated to be 85 ppd. These amounts are less than the value reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The emissions from the D-512/D-515 Atmospheric Absorber are sampled on a bi-weekly basis. The analytical results of these samples between January 2001 and mid-June 2002 indicate that the ammonia emissions from this source are relatively stable in quantity in rate. Based on this information, the emissions from the D-512/D-515 Atmospheric Absorber meet the definition of a continuous source.

### 5.5.3 Plant 5 Vent Scrubber, D-511

The D-511 Vent Scrubber is a continuous source of ammonia emissions. Ammonia is released as a result of urea production. Agrium reports the upper bound of ammonia released on a daily basis as 1,000 ppd. A lower bound for this source is not reported.

The D-511 Vent Scrubber is similar to the D-408 Vent scrubber in that it removes ammonia from the inert gas stream that results from injecting air into the $CO_2$ stream sent to the urea plant. Because the removal efficiency of this scrubber is not 100 percent, ammonia is released to the atmosphere continuously.

Agrium analyzes the emissions from the D-511 Vent Scrubber for ammonia every two weeks. Agrium provided the START-2 with all of the estimated emission rates from January 2001 to mid-June 2002 (Appendix B). The emission rates are calculated from the analytical results of the emission samples. According to the data from the past year and a half, the average amount of ammonia released to the atmosphere from the D-511 Vent Scrubber is 52 ppd. The maximum amount of ammonia released to the air was calculated by Agrium as 1,410 ppd. This upper bound is higher than the upper bound reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The emissions from the D-511 Vent Scrubber are sampled on a bi-weekly basis. The analytical results of these samples between January 2001 and mid-June 2002 indicate that the ammonia emissions from this source are relatively stable in quantity in rate. Based on this information, the emissions from the D-511 Vent Scrubber meet the definition of a continuous source.

### 5.5.4 Plant 5 Exchanger, E-535

The E-535 Exchanger is a continuous source of ammonia emissions. Ammonia is released as a result of urea production. Agrium reports the upper bound of ammonia released on a daily basis as 240 ppd. A lower bound for this source is not reported.

The E-535 Exchanger is the last exchanger in a series of four condensers that condense the ammonia and $CO_2$ contained in the waste gas resulting from the urea synthesis process. While urea is being synthesized, the condensate and carbamate are being captured for recycle. Not all of the ammonia and $CO_2$ is removed from the waste gas during the condensation process. Because a vacuum is used to condense the ammonia and $CO_2$, if pressure is not vented from this particular exchanger, pressure will build up in the first three condensers. If pressure builds up in these condensers, then condensation would not occur. A vent on the E-535 Exchanger prevents the buildup of pressure in the first three condensers. Emissions from this vent are discharged directly to the atmosphere instead of to the small flare or to a vent scrubber.

Agrium calculates the emission rate from this source by multiplying the gas flow rate by the weight percent of ammonia in the gas stream. Agrium estimates the gas flow rate to be 200 pounds per minute and estimates the maximum weight percent of ammonia in the gas stream to be 5%. Based on this information, the release rate from this source is estimated to be 240 ppd.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The calculated emission rate indicate that the ammonia emissions from this source are relatively stable in quantity in rate. Based on this information, the emissions from the E-535 Exchanger meet the definition of a continuous source.

### 5.5.5 Plant 5 Cooling Tower, E-711

The E-711 Cooling Tower is an intermittent source of ammonia emissions and occurs as a result of a Process Condensate Stripper outage. The Process Condensate Stripper outage occurs once every four years during a plant turnaround. The upper bound of the daily release rate is reported by Agrium as 6,200 ppd. No lower bound is reported for this source.

Like the Plant 2 Cooling Tower, the E-711 Cooling tower receives waste steam and process condensate from Plants 4 and 5. The E-711 Cooling Tower operates in the same was the E-611 Cooling Tower in Plant 2 operates (Section 5.2.6). As discussed in Section 5.2.6, during a Plant 4 turnaround, the Process Condensate Stripper is inoperable but is still receiving waste steam and process waters from Plant 1. During this time, the process condensate from the stripper is sent either to the E-611 (Plant 2) Cooling Tower or the E-711 (Plant 5) Cooling Tower, but not to both. Therefore, this release occurs only during a Plant 4 turnaround when the decision is made to direct the process condensate water to the E-711 Cooling Tower instead of the E-611 Cooling Tower.

The calculations for the E-711 Cooling Tower are identical to the calculations for the E-611 Cooling Tower. Agrium calculates the amount of ammonia released from a cooling tower during a Process Condensate Stripper outage as 6,200 pounds per day (Appendix B).

Ammonia emissions from the E-711 Cooling Tower would occur during a Plant 4 turnaround, which is a planned and routine event. Ammonia emissions from this source typically are zero so the exhaust from the E-711 Cooling Tower is vented to the atmosphere instead of being directed to a flare. However, when the Process Condensate Stripper is shut down during the Plant 4 turnaround, the ammonia emissions are released to the atmosphere continuously and at a rate that is predictable. It should be noted, however, that if the decision is made to direct process condensate water to the E-611 (Plant 2) Cooling Tower during a Plant 4 turnaround, then emissions from this source are zero. Based on this information, the E-711 Cooling Tower source can be considered continuous.

### 5.5.6 Plants 4 & 5 Vent/Flare Stack, B-502

The B-502 Vent/Flare Stack is a continuous source of ammonia emissions. Ammonia is released as a result of ammonia and urea production. Agrium reports the upper bound of the daily release rate 5,400 ppd. No lower bound is reported for this source.

Like Plant 2, Plant 5 has two flares: a large flare for burning ammonia associated with emergencies and large process upsets and a small flare for combusting ammonia resulting from normal operations. The B-502 Vent/Flare Stack is the small flare that burns ammonia emissions from normal process operations associated with Plants 4 and 5. The B-502 Vent/Flare Stack burns 99.5% of the ammonia vapors that pass through it and discharges the uncombusted ammonia to the atmosphere. The ammonia entering the flare comes from tank vents, pressure relief valves, and other equipment that discharge ammonia. The exhaust from a majority of the tank vents and pressure relief valves in Plants 4 and 5 are piped to this flare. The flare is sized to handle the emissions from normal operations and small upsets. Ammonia from larger process upsets is sent to the emergency flare discussed in Section 5.5.7.

Agrium provided the START-2 with spreadsheet calculations for their routine and continuous ammonia release sources related to the B-502 Vent/Flare Stack. This spreadsheet is provided in Appendix B. The spreadsheet presents the amount of ammonia burned by the small flare on a bi-weekly basis from January 2001 until mid-June 2002. Based on the totalizer information, the average amount of ammonia burned by the B-502 Vent/Flare Stack on a daily basis is 2073 ppd. Assuming that the flare's combustion efficiency is 99.5%, the average amount of ammonia released from this source is calculated to be about 10 ppd. Based on the monthly averages recorded between January 2001 and July 2002, Agrium calculated the upper bound of the daily release rate from this source as 5,100 ppd. Agrium assumes that the upper bound of the reported daily release rate will be actualized when the B-502 Vent/Flare Stack is down for repair. At this time none of the ammonia passing through the flare is being combusted. To conservatively estimate the upper bound of the amount released during this scenario, Agrium used the maximum recorded amount of ammonia passing through the small flare. The upper and lower bounds calculated using the spreadsheet fall within the upper and lower bounds reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The amount of ammonia entering the B-502 Vent/Flare Stack is continuously monitored, making the emission rate from this source easy to quantify. Based on the information provided by Agrium, it appears that the B-502 Vent/Flare Stack meets the definition of a continuous source.

### 5.5.7 Plants 4 & 5 Emergency Flare, B-501

The B-501 Emergency Flare is a continuous source of ammonia emissions. Ammonia is released as a result of the equipment design. Agrium reports the upper bound of the daily release rate 7,600 ppd. No lower bound is reported for this source.

The B-501 Emergency Flare is designed to accommodate flow rates associated with process upsets that cannot be handled by the B-502 Vent/Flare Stack. During a process upset, the gas stream is diverted immediately to the B-501 Emergency Flare. The emergency flare is separated from the small flare by a buckle pin valve.

The design of the buckle pin valve is such that the valve can open immediately in the event of a process upset or a pressure relief valve lifting that the small flare cannot handle. One of the tradeoffs of the design is that in order for the valve to open so rapidly, the valve seat cannot be completely sealed. Because the valve seat in the buckle pin valve is not completely sealed, some of the ammonia entering the small flare escapes through the gap in the seal to the emergency flare. Ammonia passing through the emergency flare during non-emergency operations is not combusted before being discharged to the atmosphere.

Agrium provided the START-2 with spreadsheet calculations for their routine and continuous ammonia release sources related to the B-501 Emergency Flare. The spreadsheet is provided as supporting documentation in Appendix B. Agrium analyzes the emissions from the B-501 Emergency Flare on a bi-weekly basis. From this data, Agrium calculates the average tons of ammonia released per day from this source. Agrium provided the START-2 with the analytical data from January 2001 to mid-June 2002. Based on this data, Agrium estimates the average amount of ammonia released from this source daily as 418 ppd. The maximum amount of ammonia released from this source between January

2001 and mid-June 2002, is recorded as 1,686 pounds per day. These amounts fall within the range reported in Agrium's CR-ERNS report.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. Emissions from the B-501 Emergency Flare are monitored on a bi-weekly basis. Analysis of the emissions indicate that the amount of ammonia released from this source is relatively stable in quantity in rate. Based on the information provided by Agrium, it appears that the B-501 Emergency Flare meets the definition of a continuous source.

## 5.6 TEMPORARY SOURCES

Between January 2001 and February 2002, Agrium notified the EPA of two additional sources of ammonia emissions. According to Agrium, these sources are temporary until measures are be taken to eliminate emissions from them. The two temporary sources are discussed in this section.

### 5.6.1 Plant 2 Ammonia Preheater, E-427

This release began on February 1, 2002, and was terminated on February 18, 2002 (Agrium 2002). The E-427 Ammonia Preheater was a continuous source of ammonia emissions. Ammonia was released as a result of an equipment failure. Agrium reported the upper bound of the daily release rate as 10,000 ppd. No lower bound was reported for this source.

The E-427 Ammonia Preheater is a shell and tube heat exchanger with ammonia flowing through the tube side and steam flowing through the shell side. Around February 1, 2002, the E-427 Ammonia Preheater developed a leak on the tube side that allowed ammonia to enter the 550-pound steam system. The 550-pound steam is used throughout the facility in a number of processes. Given that the steam is used throughout the facility, Agrium believes that ammonia, carried by the steam, was being released through several steam vents and from the cooling tower. In order to repair the leak in the E-427 Ammonia Preheater, Agrium determined that the entire plant would need to be shut down. Agrium shut down Plant 2 on February 18, 2002, and fixed the E-427 Ammonia Preheater, thus eliminating it as a source of continuous emissions.

Laboratory analysis of the steam indicated that between 8,000 ppd and 10,000 ppd were being released. Throughout the duration of the release, Agrium monitored the steam to assure that the amount of ammonia entering the steam system remained stable in quantity and rate.

The E-427 Ammonia Preheater was a continuous source of ammonia emissions between February 1 and 18, 2002. The source was discovered as a result of an equipment failure. Typically, releases from equipment failures do not qualify for reduced reporting under CR-ERNS; however, this release appears to meet the definition of continuous. The release occurred without interruption or abatement and was stable in quantity and rate.

### 5.6.2 Plant 2 Effluent Accumulation Tank, F-434

This release began on December 18, 2000, and has yet to be terminated (Agrium 2002). The F-434 Effluent Accumulation Tank is a continuous source of ammonia emissions. Ammonia is released as a result of the pressure relief valve on the tank being sized too small. Agrium reports the upper bound of the daily release rate as 8,400 ppd. Agrium reports the lower bound for this source as 100 ppd.

The F-434 Effluent Accumulation Tank collects ammonia and urea solutions from sources throughout Plant 2. Prior to December 18, 2000, ammonia vapors from this tank were recovered in a scrubber. On December 16, 2000, Agrium found that the F-434 Effluent Accumulation Tank had released ammoniated water to its containment. The release was believed by Agrium to have resulted from a split in the tank bottom thought to be caused by an over-pressurization of the tank. Agrium attributes the tank being over-pressurized to the pressure relief valve on the tank being undersized. To prevent over-pressurization in the tank from re-occurring, Agrium made the decision to leave the vent on the F-434 Effluent Accumulation Tank open to the atmosphere.

The F-434 Effluent Accumulation Tank holds about 25,000 gallons of urea solution that typically contains low levels of free ammonia. The ammonia evaporates from the urea solution and escapes through the vent on the tank. During a plant startup, the tank contains a larger volume of urea solution and therefore, a larger amount of ammonia. The upper bound of the release rate is expected to be seen during a plant startup. The release will be terminated once a properly sized pressure relief valve can be installed on the F-434 Effluent Accumulation Tank. This can only be done during a plant shutdown. According to Agrium, Plant 2 will be shut down sometime in 2003.

Ammonia emissions from this source are continuous as they occur without interruption or abatement. The amount of ammonia released from the F-434 Effluent Accumulation Tank is stable in quantity and rate. Based on this information, the F-434 Effluent Accumulation Tank qualifies as a continuous source.

# 6. CONCLUSIONS

On June 3, 2002, the EPA tasked the START-2 with conducting a continuous release investigation at Agrium's Kenai Nitrogen Operations facility in Kenai, Alaska. Agrium's KNO facility reports a total of 34 ammonia releases as continuous and stable in quantity and rate. Agrium also reported a temporary release as continuous during February 2002, which temporarily brought the total number of continuous releases up to 35. The objective of the investigation was to determine if the releases reported in Agrium KNO's CR-ERNS report (CR-ERNS Number 44607) qualify for continuous release reporting as outlined in 40 CFR 302.8.

The START-2 focused the continuous release investigation on those sources whose maximum daily release rate exceeded the RQ; however, the START-2 did not include release sources that involve fugitive emissions as part of the investigation. Of the 23 sources[5] reviewed, all but one appear to qualify for reduced reporting under 40 CFR 302.8. Ammonia releases from the F-287 Ammonia Drain Tank source do not appear to meet the definition of "continuous". A release from the F-287 Ammonia Drain Tank occurs when the B-501 Emergency Flare is activated and happens to coincide with an event where the F-287 Ammonia Drain Tank is being emptied. Emptying the F-287 Ammonia Drain Tank is a planned and routine event; however, activation of the B-501 Emergency Flare is not. Because the frequency of releases from this source is not predictable, a release from this source would not meet definition of "continuous".

Additionally, during the investigation, Agrium informed the START-2 that some of the information currently contained in their CR-ERNS report may be outdated. According to 40 CFR 302.8(i), "Each hazardous substance release shall be evaluated annually to determine if changes have occurred in the information submitted in the initial written notification, the follow-up notification, and/or in a previous change notification." It is recommended that Agrium review their CR-ERNS report on an annual basis to determine if changes in information have occurred. If changes have occurred, Agrium should update their report and make the necessary notifications regarding the changes.

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[5] One of the sources reviewed was a temporary source that is no longer releasing ammonia. The source was eliminated in February 2002.

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## 7. REFERENCES

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